New South Wales Board of Trade

NEW SOUTH WALES.

FOOD.

A Memorandum Prepared in Connection with an Inquiry to be made by the N.S.W. Board of Trade.

BY

D. T. SAWKINS, M.A.,

Statistical Officer,

NEW SOUTH WALES BOARD OF TRADE.

SYDNEY:
WILLIAM APPLEGATE GULLICK, GOVERNMENT PRINTER.

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This Memorandum has been prepared for the use of persons interested in the proceedings of the New South Wales Board of Trade upon an inquiry with respect to the cost of living and a living wage, to be opened on the 5th July, 1920. This inquiry is provided for by Section 79 of the Industrial Arbitration Act, 1912-19.

Board of Trade Office,

25th June, 1920.

Memorandum ordered to be printed and published by resolution of the New South Wales Board of Trade, passed on the 25th June, 1920.

H. L. Lamond,
Secretary.

Office of the New South Wales Board of Trade,
University Chambers,
78 Elizabeth-street, Sydney,
25th June, 1920.

THE NEW SOUTH WALES BOARD OF TRADE.

Inquiry into Cost of Living of Adult Males, 1920-21.

Memorandum by the Statistical Officer.

3rd June, 1920.

FOOD.

The Board of Trade indirectly expresses its ideas with regard to diet in formulating a regimen whose cost enters as one of the elements of the average cost of living.

The regimen hitherto adopted by the Board may or may not be satisfactory.

The regimen should satisfy two requirements:—

(1) When tested by physiological principles it should be adequate for the worker and family contemplated by the Board.

(2) It should not depart widely, without good reason, from the usage of the community.

The problem is, therefore, partly physiological and partly statistical.

The following notes may be of value in the earlier stages of the discussion:—

Basal Metabolism.

Professor E. H. Starling, who, with Professor T. B. Wood, represented the United Kingdom on the Inter-Allied Food Commission, states that the basal metabolism of the average man between ages 20 and 50, that is, the energy requirement of, for example, a man in bed before breakfast, is 39·7 Calories* per square metre of body surface per hour.† The basal metabolism is thus, on the average, proportional to the area of the surface of the body. It therefore varies among races of men, or groups of men of the same race, according to stature. For example, Dr. Langworthy, successor of Professor Atwater, the famous investigator of the United States Bureau of Agriculture, found that the energy requirements of Japanese professional and business men were but two-thirds of those of Americans in similar employment, the average weight of the former being 105 pounds and of the latter 150 pounds.‡ The mean heights and weights of men are given by Professor Starling as follows:—

Mean Heights and Weights.

British Association (1883) found for England..	5 ft. 7·4 in.	155 lb.
American and Canadian insured men, 1912	5 ft. 8·5 in.	155 lb.

The weights given are inclusive of clothes. Allowing 10 lb. for clothes, the surfaces are found by an established formula to be as follows:—

Average Body Surface.

English	1·772 sq. metres.
Americans and Canadians	1·792 sq. metres.

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* A Calorie is roughly the amount of heat required to raise one pound of water 4° Fahrenheit, and is mechanically equivalent to nearly 1·54 foot-tons.

† "The Feeding of Nations," by E. H. Starling, C.M.G., M.D., &c., Longmans, 1919.

‡ "Food Customs and Diet in American Homes," by C. F. Langworthy, Ph. D.—Circular 110, Office of Experiment Stations, U.S. Dept. of Agriculture, Washington, 1911.

Taking the latter figure as the most recent, Professor Starling finds 71·1 Calories per hour, or 1,706 Calories per day, for the basal metabolism of the average man. Statisties of the average height and weight, or body surface, of Australians are not available. The Australian Mutual Provident Society has been asked to provide such statistics for insured persons in its ordinary and industrial braneches, and if the Society can see its way to prepare these figures it will be possible to establish the basal metabolism of Australians on an adequate basis.

Energy Requirements of the Average Man.

From the basal metabolism Professor Starling deduces by rough methods the average energy requirements of a man during a day of average life. He divides the day into three equal parts, viz., eight hours of sleep, eight hours of sitting, walking, &e., and eight hours of work. The energy requirements of merely sitting are estimated by Professor Lusk, who, with Professor Chittenden, represented the United States of America on the Inter-Allied Food Commission, at 5 per cent. beyond the basal metabolism. Estimates have also been made by Professor Lusk and others of the energy requirements during other activities. The Americans are conspicuous investigators in this direction, particularly Professor Benedict, of the Offiee of Experiment Stations of the United States Department of Agriculture.* Taking the various ordinary activities as a whole, Professor Starling estimates the extra energy requirements for them at 30 per cent. of the basal metabolism during the period of eight hours. During the period of work he estimates, from various experiments and investigations, that the energy output of the average man during eight hours is 240 Calories. Taking the efficieney of the human machine, the body, at 25 per cent., he estimates the energy requirements for this purpose at 960 Calories. Finally he adds an extra 300 Calories for locomotion. Summarising these estimates, we have—

Average Man's Energy Requirements.

	Calories.
Eight hours' sleep at 71·1 Calories per hour	569
Eight hours' awake at 71·1 Calories per hour, plus 30 per cent.	739
Eight hours' work at 71·1 Calories per hour, plus 960 Calories	1,529
Locomotion	300
Total	3,137

As Professor Starling himself points out, the proeess of this ealculation is somewhat arbitrary. It may be regarded as a very hypothetical way of arriving at a result which the experts consider after (1) numerous experiments on men in various states of activity; (2) dividing up the total consumption of the nation amongst its units, to be somewhere near the truth. However, Professor Starling, after considering the requirements of persons in sedentary oceupations, which are eonsiderably less, takes the round number 3,000 as representing the actual energy requirements of the average man. Food purchased is not, however, all digested. Allowing 10 per eent.

* See Bulletin 175—"Experiments on Metabolism," 1907; and "A Biometric Study of Basal Metabolism in Man," by Harris and Benedict, Carnegie Institute, Washington, 1919.

to measure the unavailability for digestion of the energy as it exists in the food purchased, he arrives at 3,300 Calories as the average man's requirements of food as purchased.

At the meeting of the Inter-Allied Food Commission at Paris on the 25th March, 1918, "It was decided that a man of average weight (70 kilos or 154 lb.) doing average work during eight hours a day, requires food as purchased with an energy value of 3,300 Calories daily."*

The Inter-Allied Commission came into existence towards the end of the war. The Germans, however, in view of the British blockade, had considered their food requirements long before. By December, 1914, a body of German scientists, statisticians, and economists had voluntarily associated, inquired, and published the results of their inquiries in a work entitled "Germany's Food and England's Plan to Starve Her Out."† The publication was edited by Eltzbacher, and is usually referred to as the Eltzbacher Report. The following extract is from the English translation, p. 26:—

> "However, by statistical observation of the conditions in certain callings, ages, and ways of work we have obtained data in regard to the need of pure Calories. The results are supported and endorsed by scientific experiments of the most varied kind.
>
> Experimental and statistical methods were used extensively about fifty years ago by Carl von Voit, in order to ascertain the amount of food required under varying conditions.
>
> Later, on this basis, the following quantities were allowed as daily nourishment for a person weighing 70 kilograms and living on a mixed diet—for moderate work about 3,050 Calories, and for hard
>
> work 3,575 Calories. A similar estimate is made by Rubner; he allows for his work-category 1 (physician, light indoor employments), 2,445 Calories; for category 2 (moderate work), 2,868 Calories; for category 3 (heavy work), 3,362 Calories; and for quite exceptional activities (Upper Bavarian lumberman) up to 6,100 Calories. For many sports we can find even higher values,
>
> but as we are dealing here with the feeding of a mass of people, we need not take them into account. On the whole we should not make too low an estimate if we put the food requirements of a healthy, full-grown man at an average of 3,000 Calories."

The following is a selection of results of dietary studies of Europeans and others, made by Langworthy in 1911. Such studies were chosen "as seemed similar in purpose and method to the American work, preference being given to those which were recent and carried on with reasonable accuracy, and which, so far as could be judged, represented usual and normal rather than abnormal or experimental conditions."‡ In most cases the energy of the total diet is not given, but in the cases where both that figure and that for the energy utilised in the body are given, their percentage difference is not very different from the 10 per cent. taken by Professor Starling.

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* *The National Food Journal*, Ministry of Food, London, Vol. I, No. 19, June 12, 1918.

†English Translation—"Germany's Food; Can it Last?" By Russell Wells, and Waller, London, 1915.

‡ "Food Customs and Diet in American Homes"—Circular 110, Office of Experiment Stations, United States Department of Agriculture.

TABLE I.

Persons.	Energy.		Protein	
	Of Total Diet.	Utilised.	Eaten.	Digested.
	Calories.	Calories.	Grams. *	Grams.
United States :—				
Men at hard muscular work—				
Artisans, labourers, etc., average of 24 studies	6,485	6,000	177	162
Athletes, average of 19 studies	4,980	4,510	198	182
Men at moderate muscular work—				
Farmers, artisans, labourers, etc., average of 162 studies	3,685	3,425	100	92
Men not employed at muscular occupations—				
Business men, students, etc., average of 51 studies	3,560	3,285	106	98
Men with little or no muscular work—				
Inmates of institutions, average of 49 studies	2,820	2,600	86	80
Very poor working people, average of 15 studies	2,275	2,100	69	64
Canada—				
Factory hands, average of 13 studies	3,735	3,480	103	99
West Indies—				
Farmers, light work, Leeward Islands	.....	3,085	82	75
Ireland—				
Working-men	.....	3,107	98	90
England—				
Working-men	.....	2,685	89	82
Scotland—				
Working-men	.....	3,228	103	99
Students	.....	3,979	143	132
Finland—				
Working-men	.....	3,011	114	105
Working-men, hard work	.....	4,378	167	150
Students	.....	3,984	157	144
Sweden—				
Working-men	.....	3,281	134	123
Working-men, hard work	.....	4,557	189	174
Students	.....	3,032	127	117
Russia—				
Factory hands	.....	3,194	119	109
Miners, hard work	.....	4,000	155	143
Northern Italy—				
Labourers	.....	3,655	125	115
Southern Italy—				
Labourers	.....	4,400	148	136
Italy—				
Farmers and mechanics	.....	3,400	125	115
Germany—				
Working-men, hard work	.....	3,061	134	123
Farmers	.....	4,530	137	126
Professional men	.....	2,511	111	102
France—				
Men, light work	.....	2,750	110	101
Farmers (south of France)	.....	4,570	149	137
Belgium—				
Working-men	.....	3,000	92	84
Farmers	.....	4,370	136	125
Poland—				
Well-to-do families	.....	3,015	121	111

* 1,000 grams (1 kilo.) = 2·205 lb. nearly.

TABLE I—*continued.*

Persons.	Energy.		Protein.	
	Of Total Diet.	Utilised.	Eaten.	Digested.
	Calories.	Calories.	Grams.	Grams.
Japan—				
Labourers	.....	4,415	118	103
Labourers, hard work	.....	5,050	158	137
Farmers	3,091	2,823	102	94
Professional and business men	.....	2,190	87	75
Students	.....	2,800	98	88
Java—				
Men, light work	.....	2,500	73	67
Philippines (native of Tay Tay)—				
Average person	2,700	2,457	90	83
Men at hard work	3,100	2,821	100	92
China (Lao-Kay)—				
Labourers	.....	3,400	91	83
Anam—				
Labourers	.....	3,466	134	123
Egypt—				
Native labourers	.....	2,825	112	103
Congo—				
Native labourers	.....	2,812	108	99

Langworthy, interpreting these figures, says that the majority of the results if reduced to a common basis of stature do not differ very markedly from a general average. "Although the food may differ very decidedly, the nutritive value of the diet in different regions is very much the same for a like amount of muscular work."* He quotes Paton and Dunlop,† of Edinburgh: "The study of the ordinary diets of the labouring classes in all countries seems to show that whenever possible a diet is secured which will yield something over 3,000 Calories of energy and over 100 grams of proteids per man per diem." Langworthy infers: "It seems probable that, as these authors suggested, so many varied races could not be mistaken in their food demands, and that this quantity does approximately represent the demand of the body for nourishment under the given circumstances."‡ "As a result of the dietary studies which have been made, and other data," he lays down the following standard:—

Dietary Standard for a Man in Full Vigour at Moderate Muscular Work.

	Calories.
Food as purchased	3,800
Food eaten	3,500
Food digested	3,200

Here is seen a difference of 20 per cent. between the energy value of food as purchased and that of food digested, which is twice the percentage allowed by Starling. A 9 per cent. difference between the energy value of the food

* "Food Customs and Diet in American Homes," Circular 110, Office of Experiment Stations, United States Department of Agriculture, pp. 16–18.

‡ *Ibid.* p. 17.

† *Proc. Roy. Soc.*, Edinb., 25 (1904–5), p. 498.

eaten and that digested seems to be well-established by Langworthy. At page 12 of the circular already quoted, he gives the following coefficients:—

TABLE II.

Co-efficients of Digestibility and Availability of Energy of Different Groups of Food.

	Per cent.
Meat and fish	87
Eggs	89
Dairy products	93
Total animal foods of mixed diet	89
Cereals	91
Legumes, dried	83
Sugars and starches	98
Vegetables	91
Fruits	88
Total vegetable foods of mixed diet	92
Total food	91

The difference between the energy value of the food as purchased and that of the food as eaten would almost seem to have been ignored by Professor Starling. Langworthy says: "The waste in the average American home ranges from nothing to as high as 20 per cent. of the food purchased. A fair average would be about 10 per cent." In Atwater's tables of the energy values of different kinds of food, allowance is made for the refuse, *e.g.*, bone and skin of meat, shells of eggs, peelings of vegetables, in food as purchased. For example, the refuse of a chuck-rib of lean beef is 23 per cent., of ox-tail 30 per cent., of chicken 42 per cent., of fruits and vegetables up to 60 per cent., and so on. But, of course, no allowance is made for food, such as fat, left on the plate, or fat which sticks to the frying pans and baking dishes, and is washed away through the sink, or of stale bread which is thrown out, and may or may not be partly recovered after transformation into eggs or fowl flesh. According to the Eltzbacher report, Rubner demonstrated that 20 grams of fat per head of the population appeared daily in the Berlin sewers.* As a gram of fat has an energy-value of 9·3 Calories, this waste alone represents about 5 per cent. of the total daily consumption of Calories per head. The table and kitchen wastes of a boarding-house in Connecticut were found on analysis by Atwater to contain 11 per cent. of the whole nutritive material of the food purchased. They included 20 per cent. of the protein and fats and 5 per cent. of the carbohydrates.† Analyses show generally that far more waste occurs in the case of the fats and proteins than in the case of the carbohydrates. Although Langworthy says there is no waste at all in some American homes, it would seem that some waste is almost unavoidable. Perhaps, in view of the stringent circumstances in which the Inter-Allied Food Commission deliberated, the difference between the energy-value of food as purchased and of food as eaten was deliberately and advisedly ignored. The time was no time for waste.

The prevention of waste calls for demands on the housekeeper's time, whether she does her own work or superintends it. The law of diminishing returns applies to the prevention of waste as to other activities. Up to some point the prevention of waste yields a positive saving. Beyond that point the labour of preventing the waste may be more profitably employed

* "Germany's Food: Can it Last?" By Russell Wells and Waller. London, 1915. p. 190.

† "Foods: Nutritive Value and Cost." By Professor Atwater. Farmers' Bulletin, No. 23, U.S. Dept. of Agriculture, Washington, 1894.

in some other activity. Langworthy allows 10 per cent., and then devotes a chapter to urging more scientific and careful management. Perhaps, on the whole, it would be wise to put a premium on careful management by allowing, say, 5 per cent., or at any rate something less than so large an amount as 10 per cent. Even so, Langworthy's energy-value of food, as purchased, for a man in full vigour at moderate muscular work, is about 3,650 Calories.

The energy requirements of a man with moderate muscular work stated by Langworthy are 9 per cent. greater than those stated by his predecessor, Atwater. In 1894 Atwater published the following dietary standards:—*

Table III.

	Calories.
Man with little physical exercise	2,450
Man with light muscular work	2,800
Man with moderate muscular work	3,520
Man with active muscular work	4,060
Man with hard muscular work	5,700

In the course of his investigations he found that the diet of blacksmiths in Lowell had an energy-value of 6,900 Calories, that of 237 brickmakers at very severe work in Massachusetts had a value of 8,850 Calories, while the average of five dietaries of professional men and college students in Connecticut was 4,140 Calories as purchased, of which 5 per cent. was wasted.

Voit gave dietary standards as follows:—

Table IV.

	Calories.
Average man	3,055
Soldier, manœuvres	3,348
Soldier, war-time	3,575

Professor Starling, in his monograph, "The Feeding of Nations," quotes the statistics of Rowntree. Rowntree found that the average consumption of the English working-man earning more than 26s. per week in pre-war times was 3,390 Calories, and that of the average man in the servant-keeping household 3,807 Calories. Professor Starling draws particular attention to the diet of a hostel for munition workers during the war, where detailed records of food consumption were reliably kept. The diet there averaged 3,951 Calories per man. Laborious direct determinations by Professor Cathcart of the energy output of recruits, mostly young, in training, showed the need for a minimum daily ration of 3,750 Calories, and Professor Starling states that a ration of 3,800 Calories was adopted by the Inter-Allied Food Commission as a fair average for all classes of soldiers and sailors in the United Kingdom. For French soldiers and sailors 3,700 was the figure adopted.

For comparison with these direct determinations of the energy needs of groups or classes of persons, the average national consumption is most important. The committee of the Royal Society which, at the request of the Board of Trade, reported on the Food Supply of the United Kingdom in 1917,† from the statistics of total consumption in a period of five years before the war (1909-13), found that the average consumption per head was equivalent to 3,091 Calories daily. Using Atwater's coefficients for the relative energy requirements of men, women, and children of various ages,

* "Foods: Nutritive Value and Cost." By Professor Atwater. Farmers' Bulletin No. 23, U S. Dept. of Agriculture, 1894.

† Cd. 8421.

they found that this gross ration was equivalent to 4,009 Calories per man. Had Professor Lusk's coefficients been used the gross ration would have been equivalent to 3,700 Calories per man. The committee also gave in their report the calculations made by Professor Thompson which showed a gross ration equivalent to 2,980 Calories per head, or 3,864 Calories per man using Atwater's coefficients, or 3,570 Calories per man using Lusk's coefficients.* These gross values are somewhat lower than those given in an earlier estimate made by Professor Thompson in an article contributed to "Nature" of 17th February, 1916. The gross values "available for consumption" are subject to a deduction for loss in distribution. In the article abovementioned Professor Thompson states that such losses are placed between 5 per cent. and 10 per cent. If such a deduction is made it appears that, using Lusk's coefficients, the average consumption per man in the United Kingdom in pre-war times of food as purchased lay somewhere between 3,200 and 3,520 Calories. In France, before the war, Professor Starling says the gross ration per man was 3,800 Calories (based doubtless on Atwater's coefficients), exclusive of cottage and garden production. The latter the Royal Society Committee estimated for the United Kingdom at about 200 Calories per man if farm produce consumed by producers be included, and Professor Thompson, excluding such farm produce, estimated the cottage produce at about 60 Calories per man. The average consumption in France appears, therefore, to have been similar to that in the United Kingdom. The gross consumption per head of population in Germany of food as digestible was 3,642 Calories.† Allowing Langworthy's 9 per cent. difference between food as digested and food as purchased, this is equivalent to about 3,970 Calories per head as purchased, or using Lusk's coefficients, 4,750 Calories per man. If the mean—7½ per cent.—of Professor Thompson's limits for the loss in distribution be taken, this becomes 4,400 Calories per man. About one-seventh of this by weight was fat, and Rubner's conclusion with regard to the wasted fat in the Berlin sewers has already been noted. However, it appears that before the war the average German consumed more Calories than the average Briton or Frenchman.

The extensive household budget inquiry carried out by the U.S. Bureau of Labour Statistics in 1918-19, which covered nearly 13,000 families in ninety-two towns and cities in the United States, has been analysed as regards diet by Professor Ogburn.‡ The method of survey was such that usually the agent could obtain accurately from the housewives information with regard to the amount and price of the 145 articles of food scheduled, only for a short period, such as a week, and had to compute the yearly consumption by multiplication, due consideration being given to seasonal variations and family circumstances. The work was done however, states Professor Ogburn, with extreme care, and the results may be accepted as accurate within a narrow margin of error if the survey be regarded as a cost-of-living study and not a dietary study.§ Professor Ogburn states that it seems impossible to get some single unit of measurement for the adequacy of diet. A partial solution at least is, however, he considers, afforded by the fact that those dietaries of the survey which yield 3,500 Calories per man per day are usually abundant and varied enough to be fairly well balanced and fairly adequate in the amounts of the necessary constituents. Pro-

* See also "The Feeding of Nations," p. 44, where Starling gives 3,600 Calories using Lusk's coefficients.

† "Germany's Food; Can it Last?" p. 75; and "The Food Supply of the United Kingdom," Part I, Appendix III. [Cd. 8421.].

‡ *Monthly Labour Review*, U.S. Bureau of Labour Statistics, Aug., 1919.

§ *Ibid.*, p. 2.

fessor Ogburn quotes the results of a study* of the food consumed in training camps for soldiers in the United States, which showed an average energy-value of 3,900 Calories per man per day, including food consumed outside the messes. Professor Ogburn comments on the range of energy-value which was obtained for the same average expenditure. The coloured families of New Orleans get more Calories for their money than do the white families. If the food consists largely of cereals and fat meat the energy-value will be very high for the cost, while if much lean meat is consumed the energy-value will be very low for the cost. Professor Ogburn used the coefficients of relative consumption of men, women, and children adopted by the U.S. Bureau of Statistics. Had Professor Lusk's coefficients been adopted he would have arrived at about 3,200 Calories per man instead of 3,500.

Variability of Energy Requirements.

The great variability of energy requirements among individuals, of which Table I and others afford evidence, is well brought out in a recent investigation by Carl Tigerstedt. Thus among sixty-four men the gross energy requirements varied from 4,612 to 1,942 Calories, the average being 3,406 Calories per day. The following table shows the distribution:—

TABLE V.

Frequency of Energy Requirements of Various Amounts.

Amount in Calories.	No. of men.	Per cent. of total number of men.
Greater than 4,500	3	4·7
4,000—4,500	11	17·2
3,500—4,000	12	18·8
3,000—3,500	16	25·0
2,500—3,000	18	28·1
2,000—2,500	3	4·7
Less than 2,000	1	1·6
Total	64	100·0

In a recent series of experiments on basal metabolism by Harris and Benedict† 136 men were studied. They varied considerably in stature and age. The basal metabolism varied from 997 to 2,559 Calories per day, and the average was 1,632 Calories per day. This average is rather less than the value taken by Professor Starling. Harris and Benedict propounded a new formula for basal metabolism which contained a term corresponding to the age of the person considered. In view of this great variability among individuals Professor Starling states that any rationing scheme must fail if it comprises all the chief kinds of food. Latitude must be left for the satisfaction of individual needs by leaving some important item unrationed. He recommends bread for this purpose. Although this Board takes a specific dietary scale as a basis for its assessment, it does not, of course, ration the articles included in that scale. It is the price of a certain adequate diet which is distributed as part of the wage, and the recipient of that price is not restricted to the particular diet which forms the basis of the assessment. The recipient is, of course, restricted by the total price, but it will

* "Preliminary Results of Nutritional Surveys in U.S. Army Camps," Merlin and Miller, *American Journal of Public Health*, June, 1919.

† "A Biometric Study of Basal Metabolism in Man," by Harris and Benedict, Carnegie Institute, Washington, 1919, pp. 40 *et seq.*

be shown, at a later stage, that a wide range of Calorific values can be obtained with that price while maintaining reasonable proportions between the proteins, fats, and carbohydrates.

Nutritive Constituents of Food.

For the determination of energy-values, food is analysed into proteins, fats, and carbohydrates. *Protein* is a term used to include nominally the total nitrogenous substance of food materials excluding the so-called nitrogenous fats. Actually it is employed to designate the product of the total nitrogen by an empirical factor, generally 6·25*. "A man's need of protein means nothing else than need of building material, and the necessity for a supply of protein only comes into consideration so far as it provides building material. In this particular, protein cannot be replaced by any other nutrient."† "The proteins supplied over and above the actual requirements for building do not build additional body tissue, but provide energy which could be at least as well provided by other nutrients, *i.e.*, carbohydrates or fats."‡ "Voit has allowed 104 to 106 grams of digestible protein for a man weighing 70 kilograms (as he was reckoning in crude protein he put it at 118 grams). This high figure is purposely chosen, because he believed that on the basis of a normal diet we could easily exceed our requirements and because we must, above all, see to it that there is no danger of too small a supply of protein; the figure represents the consumption of protein to be recommended rather than that vitally necessary."§ According to Voit, then, 89 per cent. of the protein is digested. Benedict,‖ however, gives 92 per cent. Langworthy¶ gives 92 per cent. "In the meantime, statistical material has considerably increased. In 1902 Neumann made a summary of the literature, with the result that in the case of 144 out of 245 individuals (*i.e.*, 58·8 per cent.), and in the case of thirty-seven out of sixty-two families or larger groups (*i.e.*, 59·7 per cent.), the supply of protein was below Voit's figure. An average of all 307 observations gives for a person weighing 70 kilograms a consumption of about 98 grams of digestible protein (109·7 grams crude protein); an average of the 181 cases in which the supply of protein was below Voit's standard gives a consumption of about 71 grams digestible protein (80·2 grams crude protein). In 1913 Schumburg, after consideration of numerous later researches, came to the conclusion that most people in Germany and America can manage with 70 grams of digestible protein for moderate work."** Thus the Germans went to great pains to prescribe a proper amount of protein. Professor Starling, however, quotes Bayliss' dictum: "Take care of the Calories and the proteins will take care of themselves." Professor Chittenden, a more recent authority than some of those quoted in the above extracts from the Eltzbacher Report, who, with Professor Lusk, represented America on the Inter-Allied Food Commission, has attracted particular attention by his continual attacks on the view generally accepted until recent times that dietetic customs and habits form the best guide to the food requirements of the body. He has carried out extensive researches showing that in the average man nitrogen equilibrium can be maintained with an intake of 50 or 60 grams of protein daily. "Any habitual excess of food, over and above what is really needed to meet the actual wants of the body, is not only uneconomical, but may be distinctly disadvantageous. Voit, among others, has clearly emphasised the general

* "The Chemical Composition of Food Materials," by Atwater and Bryant. Bulletin No. 28 (Revised Edition), U.S. Department of Agriculture, 1902.

† Eltzbacher Report, English Translation, p. 29.

‡ *Ibid.* p. 30.

§ *Ibid.* p. 32.

‖ *American Journal of Physiology*, XVI, 409, 1906.

¶ "Food Customs and Diet in American Homes." Circular 110. Office of Experiment Stations, U.S. Department of Agriculture, 1911.

** Eltzbacher Report. English Translation, p. 33.

principle that the smallest amount of proteid, with non-nitrogenous food added, that will suffice to keep the body in a state of continual vigour is the ideal diet. My own conception of the true food requirements of the body has been expressed in the statement that man needs of proteids, fats, and carbohydrates sufficient to establish and maintain physiological and nitrogen equilibrium; sufficient to keep up that strength of body and mind that is essential to good health, to maintain the highest degree of physical and mental activity with the smallest amount of friction and the least expenditure of energy, and to preserve and heighten, if possible, the ordinary resistance of the body to disease germs. The smallest amount of food that will accomplish these ends is, I think, the ideal diet. There must truly be enough to supply the real needs of the body, but any great surplus over and above what is actually called for may in the long run prove an undesirable addition."* The physiological optimum is, therefore, according to Chittenden, the physiological minimum. Chittenden's view is supported by Benedict, whose recent investigations have been widely quoted. "Food," says Benedict, "should be ingested in *just the proper amount* to repair the waste of the body; to furnish it with the energy it needs for work and warmth; to maintain it in vigour; and, in the case of immature animals, to provide the proper excess for normal growth: in order to be of most advantage to the body." Professor Chittenden draws attention to the effect of false theories on dietetic customs. "Ever since Liebig advanced his theory that proteid material is the sole source of muscular energy there has been a deep-rooted belief that meat is the most efficient kind of food for keeping up the strength of the body, and hence especially demanded by all whose work is mainly physical. Although this view has been thoroughly disproved, the idea is still more or less generally held that an abundance of meat is a necessary requisite for a good day's work, a view which undoubtedly accounts in some measure for the tendency towards a high proteid intake."† Much assistance towards the maintenance of this view in Australia is provided by the advertisers of certain patent "foods" who propound on enormous hoardings the efficacy of quintessences of big and little bovine animals for keeping away the doctor. The scientists, however, say that such extracts and essences should be regarded as mere sauces whose nutritive value is negligible. For instance, rats which were fed on 4 grams of meat extract daily, died quite as soon as other rats which got no food at all. They are not stimulants; 2 oz. of Liebig's extract can be taken at one time by a healthy man without effect on the force or rapidity of the pulse, without, indeed, producing any effect other than slight diarrhœa. Used in small quantities they may aid digestion, just as mint sauce with lamb or spices with veal may render those immature meats more appetising; they may even prove to contain vitamines; but their actual nutrient qualities may be gauged by the fact that 1 lb. of dried extract, even of those brands which contain meat fibre, contains but little more than half the amount of protein which is contained in 1 lb. of plain dried lean meat.‡

Professor Lusk supports Chittenden's view. "Experiments in my laboratory show," he says, "that if meat in large quantity is given, the extra heat production following upon work amounts not only to the quantity demanded for the work accomplished, but also there is added the considerable quantity of heat produced by the stimulation of metabolism through the substances formed in the breakdown of the protein. Meat, therefore, is not the great provider of energy for the accomplishment of mechanical work, but rather carbohydrate food, such as bread, macaroni, and rice, all of which are found in the dinner pail of the labourer. These

* "The Nutrition of Man." Chittenden, London 1907, p. 158.
† *Ibid.* p. 161.
‡ "Food and the Principles of Dietetics," Hutchison, London, 1916, pp. 92, *et seq.*

furnish fuel without waste, fuel for the accomplishment of the day's work. Fat undoubtedly behaves in similar fashion, though experiments to demonstrate this have not yet been instituted. Meat in quantity is not necessary for the maintenance of vigorous muscular power. It is gratifying to the palate, but Chittenden has been justified in his belief that small quantities only are essential to repair the wear and tear on the protein content of the organism."*

Reference may be made to Table I for information as to the actual amounts of protein consumed by men of different races and occupations.

Langworthy† lays down the following standard of protein consumption:—

Protein Requirements of Man in Full Vigour at Moderate Muscular Work.

	Grams of Protein.
Food as purchased	115
Food eaten	100
Food digested	95

This amount is greatly in excess of what is regarded as the physiological optimum by Chittenden. It is practically identical with Voit's standard for the average man, viz., 118 grams. Professor Starling agrees with Chittenden that 30 or 40 grams of protein per day would probably suffice, *provided that the protein is of the proper constitution.* Professor Lusk acknowledges the contributions of Dr. Mendel to research in this direction, and repeated in 1917 the view which he expressed a year before at the Washington Academy of Sciences to the effect that the Government should compel manufacturers to place on each can, package, or barrel of food sold not only the energy value of the contents, but also information showing the *grade* of the protein, if any, contained.‡

The remarks of Langworthy made after a study of the diet of all races, including Eskimos, American and Asiatic Indians, Arabs and Chinese, as well as modern Americans and Europeans, may weigh with this Board against the adoption of any revolutionary diet which may be put forward as representing dietary customs and habits peculiar to Australia. Langworthy says, "It is generally true that the more we learn about diet in remote regions, and about the kinds and amounts of food eaten, the fewer the anomalies which are found, and the closer the resemblance to more familiar conditions, particularly when comparisons are made on a fair basis as regards age, body weight, and the amount of work done."§

A gram of protein gives 4·1 Calories. A gram of carbohydrate gives 4·1 Calories. A gram of fat gives 9·3 Calories.

Very lean rump of beef contains, as purchased, according to Atwater, 14 per cent. of refuse, 61 per cent. of water, 19 per cent. of protein, 5 per cent. of fat, and 1 per cent. of ash, and 1 lb. of it, as purchased, provides 555 Calories of energy. Fat rump contains, as purchased, 23 per cent. of refuse, 36 per cent. of water, 13 per cent. of protein, 27 per cent. of fat, and 1 per cent. of ash, and 1 lb. of it, as purchased, provides 1,405 Calories of energy. A pound of butter provides 3,600 Calories. A pound of Australian white wheaten bread, a good loaf of which, according to the Government Statistician, contains 40 per cent. of water, and therefore considerably more water than American bread,‖ provides about 1,120 Calories.

* "Food Values" by Prof. Lusk, *Science* (New York), April 13, 1917.

† "Food Customs and Diet in American Homes," 1911, p. 19.

‡ *Science* (New York) N.S. Vol, XLV, No. 1163; 13th April, 1917.

§ "Food Customs and Diet in American Homes," 1911, p. 10.

‖ In "Food and How to Save it" F.E. 77, published by Ministry of Food, London, 1918, bread is analysed into 9% protein, 1% fat, 53% carbohydrate, giving 1,200 Calories per lb. Hutchison says that several samples of white bread analysed by him contained 40% of water, and about 1,120 Calories per lb.—"Food and the Principles of Dietetics," London, 1916, p. 202.

Six-sevenths of the nutritive content of bread is carbohydrate, the rest being protein with a very small quantity of fat. A pound of oatmeal provides 1,860 Calories. The nutritive content of oatmeal is analysed into carbohydrate 74 per cent., protein 18 per cent., fat 8 per cent. It is obvious that if a man needs 3,500 Calories he can get it in various ways. Thus 2 lb. of oatmeal, costing about 1s., or 2 lb. of sugar (pure carbohydrate) for 1s., will provide rather more than the necessary amount. A pound of butter for about 2s. 6d., or a pound of suet for about 1s., will suffice. The need can nearly be satisfied with about 3 lb. of bread for 9d. On the other hand, if he prefers the flesh-pots he can take about 5 lb. of lean, or more than 6 lb. of very lean, or 2½ lb. of fat, rump steak costing anything from 3s. 6d. to 8s. 6d.

Carbohydrates are, on the whole, the cheapest energy producers; fat from the carcases of animals is as cheap, but fat in the form of butter is more than twice as dear; while energy from animal protein derived from rump steak is about ten times as dear if the small amount of fat associated with very lean meat is assumed to be eaten, and about fifteen times as dear if this fat be discarded. As between fat from the carcases of animals and cereals, which contain so much carbohydrate, the advantage rests with the cereals on account of the considerable proportions of protein and fat contained by some of them, particularly oatmeal. No single animal or vegetable product, indeed, approaches oatmeal as a food. Oatmeal with milk is the food of the Scottish labourer. There are, however, limits to the replacement of fats by carbohydrates. Professor Starling says that some fat is necessary, otherwise there is excessive breakdown of proteins in the body, and poisoning results. Owing to their cheapness it is not necessary to provide a minimum for carbohydrates. But, he continues, provision of sufficient fat has proved to be in practice one of the most difficult problems. Fat is highly assimilable and almost entirely absorbed from the alimentary canal. It has the following advantages over carbohydrate:—(1) It is digested and absorbed more slowly than carbohydrate. Most of the latter is absorbed within three hours after the meal, while the most intense absorption of fat occurs at five or six hours after the meal. A meal lacking in fat, therefore, causes a deficiency in staying power. This is shown by direct experiment. Examination of the dietaries of very heavy workers, *e.g.*, lumbermen in Sweden and Canada, consuming up to 8,000 Calories per day, shows that this great increase is due to fat not to protein. Canadian lumbermen live largely on pork and beans. The Welsh miners complained during the war of weakness during the latter portion of the shift. It was found that owing to shortage of fat they were unable to take to the mines the rich home-made pastry to which they had been accustomed. (2) The question of bulk is also most important in determining the need for fat. The human alimentary canal (at any rate in our race) has been developed so as to cope with a diet in which 20 to 25 per cent. of the energy is presented in the form of fat. In order to get the same energy from carbohydrate the canal would have to be much larger. Ordinarily a person deprived of fat diminishes his total intake and lives on a lower metabolic level. It was notable that during the shortage of fat in the United Kingdom in early 1918 there was no appreciable increase in the consumption of cereals. (3) Carbohydrates are more subject to fermentation, and therefore more productive of digestive disorders than fats.

In another place Professor Starling points out that one of those most important, but little-known substances, the vitamines, is present in the fat of milk and the fat of fresh meat.

Fat, he concludes, is an essential ingredient of the diet. The Japanese soldier is said to be content with 20 grams daily, the Italian labourer with

less than 60 grams. The child at the breast takes 50 per cent. of its nutriment in the form of fat. A series of diets by Tigerstedt and by Atwater for men of different occupations show that the energy derived from fat varied from 18·4 per cent. in an insufficient diet to 39·7 per cent. Taking only the adequate diets, Professor Starling concludes that about one-fourth of the total Calories should be in fat. The normal diet of the average man, with a Calorie value of 3,300, should contain at least 75 grams of fat per day, and the proportion of Calories derived from fat to the total Calories may, he considers, be increased to 35 per cent. without harm, or perhaps with advantage; the fat ration should always be high if the energy expenditure of the body is high owing either to hard work or exposure to cold.*

It may be noted, however, that while 1 gram of fat is equal to 2¼ grams of carbohydrate in energy value, yet 1 gram of fat is but seven-ninths as effective as 2¼ grains of carbohydrate in protein-sparing power. Therefore, if the proportion of fat in a diet of given energy value be increased, the proportion of protein must also be increased. Examination of freely-chosen diets shows that this is actually done.†

To illustrate the wide variations in the composition of diets of men at moderate and hard work, particularly in regard to fat, the results of studies of English munition workers, American athletes, Swedish mechanics, and of a Japanese jinrikisha man, aged 33 years, and weighing within 2 lb. of 10 stone, are shown in the following table:—

TABLE VI.

Composition of Diets of Men at Moderate and Hard Work.

Occupation, &c.	Food consumed.			Energy Value.
	Protein.	Fat.	Carbohydrate.	
	Grams.	Grams.	Grams.	Calories.
English Munition Workers, 1917‡.....	116	141	408	3,465
Rowing Clubs in New England §	155	177	440	3,955
Bicyclists in New York §.....	186	186	651	5,005
Football teams in Connecticut and California §.....	226	354	634	6,590
Swedish Mechanics§.....	189	110	714	4,590
Japanese Jinrikisha man‖	158	26	1,031	5,050

The earlier standards of Munk, Wolff, Voit, Rubner, Playfair, and Moleschott for an active man at moderate muscular work were very similar. They averaged 121 grams of protein, 48 grams of fat, and 522 grams of carbohydrate, making in all 3,083 Calories. Atwater broke away from this tradition by prescribing 125 grams of protein, 125 grams of fat, and 450 grams of carbohydrate, having a total energy value of 3,520 Calories.

That Professor Starling's minimum of 75 grams of fat per man per day is exceedingly low in comparison with actual facts is clear from the Report on the Food Supply of the United Kingdom, 1917. It is stated in that report that the quantities of foodstuffs available during the period 1909-13 were, per man, 113 grams of protein, 130 grams of fat, and 571 grams of carbohydrate. This includes loss in distribution and waste after purchase by the consumer. The minimal physiological standard laid down in that report is 100 grams of protein, 100 grams of fat, and 500 grams of

* "The Feeding of Nations," Starling, London, 1919.

† "Food and the Principles of Dietetics," Hutchison, London, 1917, p. 28.

‡ Summary of 18,000 cases by Dr. Leonard Hill—Memo. on Workers' Food, No. 19. Cd. 8798.

§ *Farmers' Bulletin*, No. 142, p. 34, U.S. Department of Agriculture.

‖ "Digest of Japanese Investigations on Nutrition of Man," by Oshima, Director of Agricultura Experiment Station, Japan; published Washington, 1905, p. 120.

carbohydrate, giving about 3,400 Calories per day. The amount of fat available for consumption in Germany before the war was about 150 grams per man per day. This amount was considered excessive and wasteful, and it was recommended in the Eltzbacher Report that 40 grams of fat be replaced by 90 grams of carbohydrate.*

The analysis by Professor Ogburn of the diet of families included in the survey carried out by the United States Bureau of Labour Statistics, referred to above, shows that for selected families whose diet averaged in energy-value about 3,500 Calories per man per day, as calculated from the coefficients used by the United States Bureau of Statistics, the average consumption of protein was 104 grams, of fat 120 grams, and of carbohydrate 483 grams. Had Professor Lusk's coefficients of the relative consumption of men, women, and children been adopted the results would have been about 9 per cent. less. Among the results given by Professor Ogburn for separate localities are the following:—

Composition of Food in Different Localities in United States, Cost of Living Survey, 1918-19.

Locality.	Grams per man per day.			Calories.
	Protein.	Fat.	Carbohydrates.	
Atlanta	87	132	471	3,430
New Orleans (white)	104	104	516	3,420
New Orleans (coloured)	95	112	507	3,410

The geographical latitude of New Orleans is about 30 degrees and that of Atlanta about 33 degrees. That of Sydney is about 34 degrees. Apart from Atlanta and New Orleans, the variation in the consumption of protein by families in this study consuming about 3,500 Calories per man (as calculated with the Bureau's coefficients) was from 97 grams at Seattle to 117 grams at Boston. The consumption of fat varied from 106 grams at Boston to 129 grams at Denver, San Francisco, and Oakland, and the consumption of carbohydrates varied from 441 grams at New York to 514 at St. Louis. The narrow range of the results from studies covering localities so widely distributed geographically is remarkable. The proportions of the constituents of the average of these American diets were, by weight:—protein, 14·7 per cent.; fat, 17·0 per cent.; carbohydrate, 68·3 per cent.; and by energy value:—protein, 11·9 per cent.; fat, 31·8 per cent.; carbohydrate, 56·3 per cent.

Professor McCollum, of the School of Hygiene and Public Health, John Hopkins University, says "it is a common misconception that the people in the warmer regions of the world do not eat liberally of fats. They consume more fats than do the peoples living in temperate regions. This is purely a matter of convenience, and came about through the relative abundance in the tropics of oil-rich fruits and nuts. The temperate regions produce the cereals and other crops which are with few exceptions rich in carbohydrates and poor in fats. Man has adapted himself to the character of the foods which he has found available, and through long usage certain dietary habits have become fixed."†

* Eltzbacher Report, p. 189, *et seq.*

† "The World's Food"—Proceedings of Conference held by American Academy of Political and Social Science. Vol. 74/163, p. 96.

Accessory Food Substances (Vitamines).

There are several substances whose nature is as yet unknown which must be present in the diet if an animal is to grow and to remain healthy. Professor Starling describes them as follows:—Three classes have been distinguished—(1) A water-soluble substance present in oranges, lemons, fresh green vegetables, in roots and tubers, in small quantities in meat and milk, the absence of which causes scurvy. (2) A substance present in the husks of rice and in grains, in yeast and in eggs, in the absence of which beri-beri may develop. (3) A fat-soluble substance present in the fats of milk and of fresh meat, and possibly also in green vegetables, which is essential if growth is to be normally carried out. These substances are destroyed by prolonged heating, as in cooking or stewing, by drying, and by various other manipulations. Artificially-prepared foods should not be allowed to constitute too large a proportion of the diet. For example, white bread, polished rice, the majority of patent breakfast foods, preserved meats and vegetables, and dried fruits lack vitamines. No diet is satisfactory unless it contains fresh fruits and vegetables. If margarine, artificially prepared from vegetable fats and deficient in vitamines, forms an important item in the diet, it is more than ever essential that milk or milk fat should be provided for children. The three main preoccupations of the controlling authority after providing the Calories will be the maintenance of a minimum fat supply, the safeguarding of supplies of milk for children, and the production and distribution of fresh vegetable food.*

Mineral Constituents of Food.

If a diet does not provide the necessary number of Calories, or if, while providing the Calories, it does not provide the proteins, fats, and carbohydrates in rational proportions, then it fails outright. Again, vitamines are regarded by the world's authorities as of so great importance that Professor Starling asserts that after providing the Calories the main business is to provide fat, milk, and fresh vegetables, all of which are important sources of these mysterious substances or factors.

The urgency of these considerations has led to the use of the word "nutritive" in the preceding sections in a somewhat restricted sense. Everyone knows, however, that the bones of human beings and other animals contain lime and phosphorus, and, as the whole organism is ever in a state of flux, the question naturally arises in the mind of the plain man whether the skeleton needs nourishment as well as the flesh. Do we take in our diet enough lime or phosphorus or iron or other minerals?

Now that the question of Calories has become more settled, and since physiological opinion has begun to stabilise itself somewhere between the high and the low protein schools, the so-called mineral metabolism of man has received more attention.† Dietary studies show that the greatest risk of mineral deficiency is in the calcium content of the diet. Sherman and Gillet in a recent monograph,‡ summarising the results of their study of

* "The Feeding of Nations," by E. H. Starling, C.M.G., M.D., &c., Chairman of Royal Society Food Committee, Hon. Science Adviser to Ministry of Food, Member of Inter-Allied Scientific Food Commission.

† See "Calcium, Magnesium and Phosphorus in Food and Nutrition"—Bulletin 227, Office of Experiment Stations, U.S. Dept. of Agric., 1910; "The Nutrition of Man," by Professor Lusk.

‡ "The Adequacy and Economy of Some City Dietaries," by Sherman and Gillet, New York, 1917.

the diets of 102 families in New York and other American cities, conclude that "next to energy, calcium deficiency seems to offer the largest problem." They quote Professor Mendel, of Yale, to the effect that his recent nutrition experiments showed that animals may be in excellent nutritive condition, in so far as protein is concerned, for long periods of time, while they are still losing calcium from their bones, and that it then happens that suddenly a collapse comes for which there is frequently no obvious explanation. In an important bulletin of the United States Department of Agriculture* it is concluded that typical American family dietaries are frequently deficient in calcium.

If the protein allowance in the diet is reasonably liberal, there appears to be little risk of deficiency in phosphorus and iron, but the case of calcium is more difficult. The American standards of calcium intake vary from 0·7 to 1 gram of calcium oxide per man per day. Gautier, in France, and Albu and Neuberg, in Germany, hold, however, that the diet should furnish at least 1 to 1·5 grams of calcium oxide per man per day. The following table, derived from the monograph and bulletin referred to above, shows the percentage of calcium oxide, and the amount in grams, contained in 1 lb. of various food materials:—

TABLE VIA.

Amount of Calcium Oxide in Edible Portion of certain Food Materials.

Food material.	Calcium oxide.	
	Per cent.	Grams in 1 lb.
Cheese	1·24	5·6
Turnip tops (greens)	·51	2·3
Molasses	·36	1·6
Gelatine	·35	1·6
Almonds	·30	1·4
Figs, dried	·28	1·3
Watercress	·26	1·2
Beans, kidney and pea, dried	·22	1·0
Milk, whole	·17	·8 (a)
Currants, dried	·17	·8
Eggs	·10	·5 (b)
Beans, Lima, dried	·09	·4
Celery, turnips	·09	·4
Oatmeal	·08	·4
Peas, dried	·08	·4
Parsnips, carrots	·08	·4
Spinach, rhubarb, cabbage	·06	·3
Lettuce, brussels sprouts	·05	·2
Whole-meal bread, onions	·04	·2
Pumpkin	·03	·1
White bread, lean meat, fish, potatoes	·02	·1
Sugar, refined	·00	·0

(a) A pint weighs about 1¼ lb. (b) An average egg weighs 2 oz.

The table shows that a pound of cheese is worth a bushel of bread, meat, and potatoes for calcium. The despised turnip-top is eight times more valuable in this respect than the aristocratic spinach. Treacle, gelatine, and

* "Calcium, Magnesium and Phosphorus in Food and Nutrition"—Bulletin 227, Office of Experiment Stations, U S- Dept. of Agriculture, 1910.

water-cress hold very valuable percentages. The egg, even at 1s. 6d. per dozen, is an expensive source, half a dozen containing about as much as 1 lb. of mixed turnips, carrots, and cabbage.

In practice, milk is the chief source of calcium in the diet. Dietary studies show that when the supply of milk is short the deficiency in calcium is usually large. A pint of fresh whole milk per man per day nearly provides the standard gram. Therefore, in advising a plentiful supply of milk especially as a source of vitamines, Professor Starling provided also for the calcium requirements.

Energy Requirements of Women and Children.

Owing to their smaller stature, the basal metabolism of women is less than that of men. Moreover, Du Bois and others have recently found that per unit of surface the basal metabolism of women is but 93 per cent. of that of men. The average energy requirements of women vary, according to Professor Starling, between 1,800 and 3,300 Calories according to occupation. According to the Eltzbacher report, the Calories required by needlewomen have been fixed at 2,000, by sewing-machinists and bookbinders at 2,100 to 2,300, by domestic servants at 2,500 to 3,200, and by washerwomen at 2,900 to 3,700 Calories. These are on the basis of food digested; 10 per cent. should be added to bring them to the basis of food as purchased, allowing nothing for waste. Professor Starling, having taken the average energy requirements of a man at 3,000 Calories, regards 2,400 Calories as sufficient to meet the average requirements of a woman. To these he adds 10 per cent. to allow for the difference between food as purchased and food as digested. Thus 0·8 is the factor or coefficient regarded by him as fairly repesenting the average woman's energy requirements in terms of those of the average man. The Committee of the Royal Society which reported in 1917 on the Food Supply of the United Kingdom, adopting Atwater's coefficients, took 0·8 as the coefficient for the average woman. Professor Lusk's coefficient, which has been adopted by the Inter-Allied Scientific Food Commission, is 0·83. In Calories the figures of that Commission are:—

	Average Man.	Average Woman.
Energy value of food as purchased ..	3,300 Cal.	2,750 Cal.

As regards children, the present tendency is to take higher coefficients for their requirements than in the past. Du Bois and others have recently found that per unit of body surface the basal metabolism of a child of 6 years is nearly half as great again as that of a man. Long ago Hippocrates said, "Old men bear want of food best; then adults; youths bear it least, most especially children, and of them the most lively are least able to endure it." In an American boarding school the average diet of boys had a value of 5,000 Calories per day, including 600 Calories in chocolate bought by the boys. The diet of boys in English public schools is liberal; nevertheless they are always capable of consuming considerable extras bought by themselves at the tuckshop. "There is no doubt," says Professor Starling, "that the allowance for children by Atwater was too low, but if we exclude the well-fed and over-exercised schoolboys of the wealthier classes the values given by Lusk may be accepted as sufficient to secure full health and development in

the great mass of the population." The following table shows Atwater's, Langworthy's, and Lusk's coefficients as well as those of Engel, Rubner, and Zuntz. The American household coefficients given in the 18th Annual Report of the Commissioner of Labour, Washington, 1904, and still used by the United States Bureau of Labour Statistics, are also included. It will be seen that these scales show a gradually improving treatment of the needs of the adolescent.

TABLE VII.

Scale of Requirement Units according to Sex and Age.

Age.	(1 grown man = 100.) Units according to—																	
	Engel.		Rubner.		Atwater.		Zuntz.		American Household.		Lang-worthy.		Lusk.					
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.				
Under 1 year.	28·6		.....		30		20		15		30		50					
1 year.....	31·4		21·8		30		30		15		30		50					
2 years	34 3		29·7		40		40		15		40		50					
3 ,, ...	37·1		35·4		40		40		15		40		50					
4 ,, ...	40		38·8		40		40		40		40		50					
5 ,, ...	42·9		42·3		40		50		40		40		50					
6 ,, ...	45·7		43·7		50		50		40		50		70					
7 ,, ...	48·6		45·0		50		50		75		50		70					
8 ,, ...	51·4		46·4		50		50		75		50		70					
9 ,, ...	54·3		47·8		50		50		75		50		70					
10 ,, ...	57·1		49·2		60		75		75		60	60	83					
11 ,, ...	60		54·4		60		75		90		60	60	83					
12 ,, ...	62·9		59·6		60		75		90		70	60	83					
13 ,, ...	65·7		65·0		60		75		90		80	70	83					
14 ,, ...	68·6		70·6		80	70	75		90		80	70	100	83				
15 ,, ...	71·4		73·1		80	70	100	80	100	90	90	80	100	83				
16 ,, ...	74·3		75·7		80	70	100	80	100	90	90	80	100	83				
17 ,, ...	77·1		78·4		80	70	100	80	100	90	100	83	100	83				
18 ,, ...	80		81·6		100	80	100	80	100	90	100	83	100	83				
19 ,, ...	82·9		100		100	80	100	80	100	90	100	83	100	83				
20 ,, ...	85·7		100		100	80	100	80	100	90	100	83	100	83				
21 ,, ...	88·6	85·7	100		100	80	100	80	100	90	100	83	100	83				
22 ,, ...	91·4	85·7	100		100	80	100	80	100	90	100	83	100	83				
23 ,, ...	94·3	85·7	100		100	80	100	80	100	90	100	83	100	83				
24 ,, ...	97·1	85·7	100		100	80	100	80	100	90	100	83	100	83				
25-29 years...	100	85·7	100		100	80	100	80	100	90	100	83	100	83				
60 and over...	100	85·7	100		100	80	90	80	100	90	(a)		100	83				

(a) The figure 83 in Langworthy's scale is found by taking the average of the following figures given by him:—

Man, period of full vigour—

At moderate work	100
At hard work	120
At sedentary occupation	80

Woman, period of full vigour—

At moderate work	80
At hard work	100
At sedentary occupation	70

Langworthy gives also—

Man or woman—

Old age	90
Extreme old age	70-80

Atwater's and Lusk's coefficients may be shown shortly as follows:—

TABLE VIII.

Coefficients of Energy Requirement according to Sex and Age.

Age last birthday.	Atwater's coefficients	Age last birthday.	Lusk's coefficients.
	Male and Female.		Male and Female.
0- 5	0·4	0- 5	0·5
6- 9	0·5	6- 9	0·7
10-13	0·6	10-13	0·83
14-15	0·8 | 0·7	14 and over	1·0 | 0·83
16 and over	1·0 | 0·8	.....	.....

The following table shows the classification of the population of the United Kingdom in terms of food requirements made by Professor T. B. Wood, who, with Professor Starling, represented the United Kingdom on the Inter-Allied Scientific Food Commission.*

TABLE IX.

Classification of the Population of the United Kingdom in 1917-18 in Terms of Food Requirements.

Class.	Description.	Man value.	Number in millions.	Total man-value in millions.
I	Men doing heavy work	1·33	3½	4·65
II	Men doing average work Boys, growing, age 13-18 Women doing heavy work	1·00	8	8·00
III	Men doing sedentary work Women doing average work Girls, growing, age 13-18	·80	11½	9·20
IV	Women doing sedentary work, or unoccupied. Children, age 10-13	·67	10½	7·00
V	Children, age 6-10	·50	3¾	1·85
VI	Children, age 0-6	·40	5¾	2·30
	Totals ..	.....	43·0	33·00

Average man-value of population per 100=77.

* "The National Food Supply in Peace and War," by T. B. Wood, M.A., Drapers' Professor of Agriculture, Cambridge, &c. : Cambridge, 1917.

In order to calculate the man-value of the requirements of this Board's standard family of man, wife, and two children under the age of 14, we may take the frequency of children at various ages as shown at the census of 1911.

TABLE X.

Adjusted Number of Persons under 14 in Age-Groups as at the Census of 1911, New South Wales.

Age last birthday.	Number of persons.
0–5	237,450
6-9	133,200
10-13.....	124,300
Total under 14	494,950

The standard family works out as follows:—

TABLE XI.

New South Wales Board of Trade's Standard Family of Man, Wife, and Two Average Children under 14 years of age, New South Wales, 1911.

Members.	Man-value by coefficients of—		
	Atwater.	Langworthy.	Lusk.
Man	1 00	1 00	1·00
Wife	0·80	0 83	0·83
2 children	0·95	0·95	1·27
Total	2·75	2·78	3·10

Analysis of the Regimen hitherto adopted by New South Wales Board of Trade.

The regimen adopted by this Board in its declaration of the 8th October, 1919, is, in effect, six-sevenths of the dietary scale shown in Table XII following. In order to calculate the proportions of protein, fat, and carbohydrate, and the energy-value, use has been made of the values per unit of weight set out in the Report by the Committee of the Royal Society on the Food Supply of the United Kingdom, published in 1917 (Cd. 8,421), and of the original analyses by Professor Atwater, from which the Committee derived its values, in "The Chemical Composition of American Food Materials," Bulletin No. 28 (revised edition), U.S. Department of Agriculture, published in 1902. Reference may also be made to the Appendix which shows the values adopted by the Inter-Allied Food Commission.

Table XII.

Composition and Energy Value of a Dietary Scale.

(The figures refer to foods as purchased by the consumer, all refuse such as bone, skin, and parings being allowed for.)

Item.	Quantity.	Amount of Nutrients.			Energy value.
		Protein.	Fat.	Carbohydrate.	
	lb.	lb.	lb.	lb.	Calories.
Bread	20	1·600	·200	10·000	22,440
Meat :—					
(1) Very lean*	16	2.720	·432	.....	6,880
(2) Lean†	16	2·480	1·696	.....	11,760
(3) Medium fat‡	16	2·368	2·896	.....	16,640
Butter	1½	·015	1·275	.....	5,405
Oatmeal	3	·483	·216	2·025	5,580
Milk	§18	·594	·720	·900	5,850
Sugar	4	.....	.....	4·000	7,440
Jam	1	·010	.....	·500	945
Treacle	2	·018	.....	1·386	2,580
Rice	2	·160	·006	1·580	3,260
Peas	2	·492	·020	1·240	3,310
Potatoes	¶ 14	·252	·014	2·058	4,340
Raisins	1	·023	·030	·685	1,445
Tea	½	.....	.....	.....	.....
Suet	1	·047	·818	.....	3,540
Flour	4	·532	·060	2·908	6,660
Condiments	**	.....	.....	.....	.....
Fruit and Vegetables	††9	·117	·036	·972	2,160
Total in lb.—(1)*	.....	7·093	3·827	28·254	81,735
(2)†	.....	6 853	5·091	28·254	86,615
(3)‡	.....	6 741	6·291	28·234	91,495

* On the basis of Atwater's analysis for very lean beef. As 1 kilogram = 2,205 lb. approximately, the energy value of such meat is less than 1 Calorie per gram.

† On the basis of Atwater's analysis for lean beef. Energy value 1·6 Calories per gram.

‡ On the basis of Atwater's analysis for medium fat beef. Energy value 2·8 Calories per gram.

§ Seven quarts is the quantity stated in the dietary scale. See Bulletin of Living Wage (Adult Males) 1918, p. 31, and Board's Declaration of 8th October, 1919.

‖ Taken as dried peas.

¶ Twenty per cent. allowed for parings. If the potato is cooked in its skin the energy value of 14 lb. is 5,600 Calories.

** Three pennyworth allowed in dietary scale—of little or no energy value.

†† Represents the sum of 2s. 2d. converted at about 3d. per lb. The analysis is for parsnips. Grapes, plums, beans, &c., have high energy values; cabbage, *e.g.*, has a low energy value; the energy value of parsnips seems to be a rough mean for average fruit and vegetables.

This Board's regimen for man, wife, and two children under 14 years of age represents six-sevenths of the dietary scale of Table XII. Using the man-value of that family as derived by using Lusk's coefficients (*see* Table XI), the regimen works out as follows:—

TABLE XIII.

Analysis of New South Wales Board of Trade Regimen for Standard Family (3·1 units by Lusk's Coefficients).

Constituent.	Amount daily, assuming the consumption of—								
	Very lean beef.			Lean beef.			Medium fat beef.		
	Man.	Wife.	Average child under 14.	Man.	Wife.	Average child under 14.	Man.	Wife.	Average child under 14
Protein; grams	127	105	81	123	102	78	121	100	77
Fat; grams	69	57	43	91	76	58	113	94	72
Carbohydrate; grams	507	421	322	507	421	322	507	421	322
Energy-value; Calories	3,230	2,680	2,050	3,410	2,830	2,170	3,610	3,000	2,290

It will be observed that the variation in the protein content of the diet according to the kind of meat selected is almost negligible; on the other hand, an increase of 400 Calories per man per day can be got by purchasing medium fat meat instead of very lean meat.

Average Consumption in New South Wales.

The change in the average diet of the community since the year 1911 may be studied in Table XIV following. The quantities are taken from the Year Books of the Government Statistician.*

TABLE XIV.

Household Consumption per head per week of various descriptions of food in New South Wales during the years 1911, 1916, 1917, and 1918.

Description.	Energy Value per lb.†	1911.‡		1916.		1917.		1918.	
		Quantity.	Energy Value.	Quantity.	Energy Value.	Quantity.	Energy Value.	Quantity.	Energy Value.
		lb.	Calories	lb.	Calories.	lb.	Calories	lb.	Calories.
Beef	800	2·96	2,368	1·90	1,520	1·82	1,456	1·64	1,312
Mutton	900	1·87	1,683	1·40	1,260	1·34	1,206	1·20	1,080
Pork	1,550	·11	204	·04	74	·06	111	·08	148
Bacon and Ham	2,200	·20	440	·16	352	·18	396	·20	440
Fish, fresh	300	·12	36	·22	66	·20	60	·20	60
Do preserved	700	·08	56	·10	70	·10	70	·08	56
Potatoes	310	3·48	1,079	2·83	893	2·52	781	2·46	763
Flour	1,665	·80	1,332	·80	1,332	·80	1,332	·80	1,332
Bread	1,120	4·00	4,480	3·68	4,122	3·68	4,122	3·68	4,122
Rice	1,630	·16	261	·16	261	·14	228	·14	228
Sago and Tapioca	1,650	·04	66	·04	66	·04	66	·04	66
Oatmeal	1,860	·14	260	·12	223	·12	223	·12	223
Sugar	1,860	1·20	2,232	1·20	2,232	1·20	2,232	1·20	2,232
Jam	950	·32	304	·34	323	·28	266	·24	228
Butter	3,600	·50	1,800	·58	2,088	·58	2,088	·54	1,944
Cheese	1,780	·06	107	·06	107	·06	107	·06	107
Milk, fresh	325	3·48	1,131	3·89	1·264	3·94	1,281	4·04	1,313
Tea	....	·14	....	·14	....	·16	...	·16	.....
Total per week	....	....	17,839	....	16,253	....	16,025	....	15,654
Total per day	....	....	2,548	....	2,322	....	2,289	....	2,236

* Official Year Books of New South Wales; "Food and Prices"; 1911–1918.

† The energy values taken for beef and mutton are discussed in the following pages.

‡ Mean of years 1910–12 taken for meat; mean of 1907–9 taken for other descriptions of food. See Table XVIII and Official Year Book of N.S.W., for 1918, Part XII, p. 496.

It is necessary to reduce these figures, which are per head, to the corresponding figures per man of the population of New South Wales. The Committee of the Royal Society, using Atwater's coefficients, found 0·77 as the man-value per head of the population of the United Kingdom.* Professor Wood, using the same coefficients, but in addition, splitting up the population into various grades of activity, found the same value, 0·77 (*see* Table IX). Professor Starling, using Lusk's coefficients, found 0·835.†

Tables XV and XVI following show the constitution of the population of New South Wales at the Census of 1911, and the approximate constitution for the average of the three years 1st July, 1916, to 30th June, 1918, the statistical years taken by the Government Statistician in Table XIV above. The statistics of migration show that the average depletion of males during that portion of the war period was about 70,000. To these the food coefficient 1·3 has been ascribed, as these men were drawn from the more energetic sections of the community, and would therefore, had they been present, have consumed more food than the average man.

TABLE XV.

Constitution and Man-Value of Population of New South Wales, at Census, 1911.

Age and Sex.	Number in thousands.	Lusk's Coefficient.	Equivalent Men.
Under 14.....	495	0 635	314
14 and over—			
Females	544	0·83	452
Males	608	1	608
Total	1,647	...	1,374

Average Man-Value=0·834.

The average man-value thus found, viz., 0·834, is practically identical with that found by Professor Starling, using the same coefficients, for the population of the United Kingdom.

TABLE XVI.

Approximate Constitution of Population of New South Wales: Average of 3 years, 1st July, 1916–30th June, 1918.

Age and Sex.	Number in thousands.	Lusk's coefficient.‡	Equivalent Men.
Under 14	585	0·635	371
14 and over—			
Females	640	0·83	531
Males	720	1	720
Less depletion during war	−70	1·3 say	−91
Total	1,875	...	1.532

Average Man-Value=0·817.

* "Report on Food Supply of United Kingdom," 1917, Part I, Appendix II.

† "The Feeding of Nations," by Professor Starling, London, 1919.

‡ With an additional coefficient to allow for men of youth and vigour beyond the average. If, however, 1·1 or 1·2 be taken instead of 1·3, the result is but slightly affected.

Thus it appears that the man-value per head of population was reduced during the three years to which the table refers, by about 2 per cent. on an average. The apparent diminution of the energy value of the diet shown in Table XIV is, however, about 10 per cent. on an average and reaches 12 per cent. in 1917-18. Applying the figures showing the man-value of the population per head, we find that the energy value of the food covered by the Government Statistician's tables was 3,055 Calories per man per day in 1911, and 2,790 Calories per man per day on the average of the three statistical years ended 30th June, 1918.

The Statistician's figures are, of course, not exhaustive. Poultry, eggs, and rabbits are not included in Table XIV. The energy value of these amounted, before the war, to 0·9 per cent. of the total energy value of the food supply of the United Kingdom. Fruit and nuts, and vegetables other than potatoes, are not included. These formed in the United Kingdom 3·6 per cent. of the total energy value of the food supply. Cocoa and chocolate and condensed milk are not included in Table XIV. The Statistician's figures show, however, that the consumption of condensed milk is about 6 lb. per head per annum, or about 25 Calories per head per day. The produce of private gardens and that portion of the produce of farms which is consumed by the producers are not included in Table XIV. These together were estimated at about 5·2 per cent. of the total energy value of the pre-war food supply of the United Kingdom.

It is probable that, to allow for these missing items, the consumption covered by the Statistician's tables should be increased in energy value by 10 per cent. or 15 per cent. in order to arrive at the total consumption of food per head in New South Wales. On that basis it would seem that the food available for consumption in 1911 had an energy value as purchased of between 3,300 and 3,500 Calories per man per day. These are rather small figures compared with the corresponding pre-war figure for the United Kingdom, viz., 3,091, divided by 0·835 (using Lusk's coefficients), which amounts to 3,700 Calories per man per day.

The energy value per man per day of the food supply of New South Wales has been calculated on the basis of 800 Calories per lb. of beef, and 900 Calories per lb. of mutton, as purchased. The energy value of beef consumed in the United Kingdom in war time, which was largely imported, was taken by the Inter-Allied Food Commission at 1,040 Calories per lb., and of mutton at 1,270 Calories per lb. These energy-values are about 16 per cent. below the figures taken by that Commission as representing the energy values of the beef and mutton consumed in England before the war. Perhaps the Australian is a greater fat-eater than the figures taken, viz., 800 and 900 Calories, suggest. An increase of 10 per cent. in the energy values of beef and mutton so assumed would give an increase of 58 Calories per head or 70 Calories per man daily for the year 1911. Even, however, if local meat be assumed to have the war-time energy values taken by the Inter-Allied Commission, the Australian total consumption of Calories per head or per man hardly reaches the British consumption. There are, therefore, decided indications that the Australian is a smaller consumer of Calories than the Britisher.

The consumption of meat in New South Wales has diminished enormously during the war, but the Australian is still, probably, nearly the greatest meat-eater in the world. Recent statistics are not available for all countries.

The following figures are from "The World's Food," Vol. LXXIV of The Annals of the American Academy of Political and Social Science, November, 1917, p. 26:—

TABLE XVII.

Consumption of Meat in Various Countries.

Country.	Year.	Annual Consumption per Head.
		lb.
Australia	1902	263
New Zealand	1902	212
United States	1909	171
Argentina	1899	139
Canada	1910	137
Cuba	1906	123
United Kingdom	1906	118
Germany	1913	112
France	1904	79
Denmark	1902	76
Switzerland	1899	75
Belgium	1902	71
Netherlands	1902	70
Greece	1899	67
Austria-Hungary	1890	64
Norway	1902	61
Poland (Russian)	1899	61
Sweden	1902	61
Russia	1899	50
Spain	1890	48
Italy	1901	46
Portugal	1899	44

Thus in 1902 the annual consumption in Australia was 263 lb. per head. The New Zealanders were next with 212 lb. In 1909 the Americans consumed 171 lb. per head, and in 1910 the Canadians consumed 137 lb. But in 1917-18, the latest year for which the Government Statistician gives figures, meat consumption in New South Wales had dropped to 162 lb. per head. The following table* shows the average consumption in New South Wales per head in each year since 1910:—

TABLE XVIII.

Annual Consumption of Meat in New South Wales, per Head.

Year.	Beef.	Veal.	Mutton and Lamb.	Pork.	Bacon and Ham.	Total.
	lb.	lb.	lb.	lb.	lb.	lb.
1910	142·2	3·1	100·0	5·9	9·1	260·3
1911	147·6	3·3	101·3	5·0	10·7	267·9
1912	161·0	4·4	90·9	6·2	11·1	273·6
1913	148·3	4·1	93·8	3·8	9·8	259·8
1914-15	118·3	3·3	78·8	3·0	9·4	212·8
1915-16	97·1	1·6	73·1	2·0	8·0	181·8
1916-17	93·0	2·0	69·8	3·6	9·6	178·0
1917-18	83·7	1·5	62·7	4·0	10·1	162·0

The increasing consumption of pork, and bacon and ham since 1915-16 seems to indicate an effort on the part of the population to make up for the diminution in the total by increasing the proportion of fat.

* Official Year Book of N.S.W. for 1918, p. 459.

Table XIV shows a similar increase since 1911 in the consumption of butter, and of milk which also provides animal fat. There has been no tendency, Table XIV shows, to increase the consumption of carbohydrates to make up the deficiency; in fact, the consumption of bread, potatoes, rice, and oatmeal is subject in each case to a decline since 1911. Professor Starling remarked, as already quoted, a similar disinclination in Great Britain during the war.

The Government Statistician suggests that it is probable that a growing consumption of rabbits in New South Wales has partially replaced the decline in the consumption of meat. He states that the local consumption of rabbits during 1917-1918 is estimated to have amounted to 60,000 pairs per week, and that this amount was doubtless as great as for the whole period of the three years 1907 to 1909.* We may therefore take 40,000 pairs per week as representing the increase in the consumption of rabbits between about the year 1910 and the year 1917-18. Fair samples of the rabbits being sold at the present time in the butchers' shops weigh between 4 lb. and 4½ lb. per pair, and rabbits as purchased have an energy value of about 860 Calories per lb. Therefore, the decline in the consumption of those meats which are included in Table XVIII has been replaced by about 0·09 lb. of rabbit (having an energy value of about 80 Calories) per head per week, or about 4·7 lb. per year. As the decline is, roundly, 100 lb. of meat per head per year, and as the energy value of lean beef and mutton is, roughly, 15 per cent. less, and that of medium fat beef and mutton, roughly, 25 per cent. more than that of rabbit, it follows that as regards energy value the increase in the consumption of rabbits has made up for, perhaps, 5 per cent. of the decrease in the consumption of meat.

The Government Statistician also suggests that the decrease in the consumption of meat has been partially made good by an increase in the consumption of eggs.* The energy value of eggs, however, is popularly overrated. An average egg is worth about eighty Calories,† three-fifths of this coming from the fatty content. The old idea that an egg is equal to half a pound of steak is very wide of the mark. It is really equal to about an ounce of average beef containing no bone. By an *additional* consumption of from two to two and a half eggs every day by every head of the population—that is to say, by an *additional* consumption of six or seven dozen eggs every week by an ordinary household of five persons—the outstanding deficiency in the consumption of meat during the years 1916-18 might have been made up. To maintain this average, the additional consumption of eggs during the periods of plenty would have been considerably greater than, perhaps twice as great as, the average additional consumption indicated. This additional consumption of eggs, which would have sufficed to make up the deficiency outstanding after allowing for the slight effect of the increased consumption of rabbits, is so large that it may be doubted whether so much as one-quarter of it really took place.

The quantities of foods which form the basis of Table XIV are derived from results which, in the Government Statistician's own words, "have been compiled carefully, and . . . are published with a large degree of

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* Official Year Book of N.S.W. for 1918, p. 458.

† Eggs are, however, rich in important mineral matters; moreover, egg fat, like milk, butter, and the leaves of plants, is a source of one of the vitamines.

confidence as indicative of the consumption of the more important articles of diet."* Assuming, therefore, that the figures are well grounded, the inferences from them may be summarised as follows:—

(1) The total food made available for consumption in New South Wales before the War had, probably, somewhat less energy value per man per day than the pre-war consumption in the United Kingdom, assuming the same energy values for beef and mutton, viz., 1,040 and 1,270 Calories per lb., in both countries.

(2) The average consumption of the chief descriptions of food, as listed by the Government Statistician, fell, in energy value per man per day, from 3,055 Calories in 1911, to an average of 2,790 Calories during the three years ended 30th June, 1918, assuming the same energy values for beef and mutton, viz., 800 and 900 Calories per lb., during the periods compared.

(3) This fall was due for the most part to a decrease in the consumption of meat as a whole.

(4) The deficiency was not made up by an increase in the consumption of carbohydrates; in fact, the consumption of carbohydrates decreased.

(5) The increase in the consumption of rabbits may have made up for 15 of the 265 missing Calories per man per day.

(6) An increase in the consumption of eggs and poultry may have made up for, possibly, 40 or 50 further Calories per man per day.

(7) The consumption of potatoes decreased by, roughly, 25 per cent. An increase in the consumption of fruit and of vegetables other than potatoes may have taken place. Consideration of the course of prices of fruit and vegetables, their bulk and comparatively low average energy value, together with the disinclination to make up the deficiency with bulky cereals which has already been noted, indicates that any such increase amounted probably to but a small fraction of the deficiency.

(8) The consumption of fatty foods such as pork, bacon and ham, and milk, has increased noticeably since 1915-16.

(9) Much of the deficiency could have been made up by consuming the fat of meat, instead of wasting it as is implied by assigning to beef and mutton energy values so low as 800 and 900 Calories per pound.

(10) Either the inhabitants were content to live on a lower metabolic level, or they chose the simple course of eating more of the fat and dripping of meat.

(11) Probably they chose that simple course, instinctively avoiding as far as possible the unpleasant alternative.

Although an increase of 10 per cent. in the assumed energy value of beef and mutton produces for the year 1911 an increase of about 70 Calories per man per day, yet the diminution in the consumption of meat during the war was so great that a similar increase of 10 per cent. produces for the years 1916-18 an increase of only about 45 Calories per man per day. Therefore, even if we assume a 20 per cent. increase above 800 and 900 Calories in the energy value of the beef and mutton as used, the missing Calories, after allowing for the recovery indicated in paragraphs (5), (6), and (7) above, are not made up. That assumption too makes the average energy value of the total meat and fish consumption of 1916-18 work out

* Official Year Book of N.S.W. for 1916, p. 457.

at 1,040 Calories per lb. This is exactly the value for medium fat meat taken in the analysis of the dietary scale in Table XII, on which this Board's regimen is based. It seems unreasonable that the assumption of increased effectiveness of usage should go beyond 20 per cent.

The final conclusion to be drawn from the analysis of these figures is of a serious character. Unless an exhaustive investigation, at their sources, of the statistics provided by the Government Statistician shows that they are considerably in error, there is little doubt that the population of New South Wales as a whole lived on a lower metabolic level during the three war years, 1916-1918, than in the year 1911.

The effects of restriction of diet are insidious. They are not immediately felt. Professor Starling says that the inhabitants of Germany were at first able to carry out their ordinary work under the stress of the circumstances in which they were placed. The later effects are well known. Rowntree and Booth give statistics showing, as stated by Starling, that before the war 30 per cent. of the people of the United Kingdom were under-nourished. The death rates in York are given by Rowntree as follows for different classes:—

DEATH RATES IN YORK.

	Per 1,000 of Population.
Poorest class	28·8
Middle class	20·7
Highest class	13·5
Average for York	18·5

Professor Lusk says that the under-nourished may live on much less food than those who are well fed and up to normal weight. But if the workers do not get enough to eat they cannot do the same amount of work. "In buying food the labouring population is buying energy," said the Commission on the Food Supply of the United Kingdom, "and *a slight reduction* of food below the necessary amount causes *a large diminution* in the working efficiency of the individual."

Additional light will be thrown on the question of consumption in New South Wales by the statistics for the year 1919 which the Government Statistician is now preparing. These will perhaps be available in the course of a month.

The Board's Regimen compared with the Average Consumption of the Community.

In comparing the regimen hitherto adopted by this Board with the average consumption of the community as shown by the Government Statistician's figures, the former must be taken as in the hands of the consumer; while the latter, being presumably statistics of foods available for consumption, must be subjected to a deduction for loss in distribution. This was placed by Professor Thompson at between 5 per cent. and 10 per cent. in the United Kingdom before the war. In the following table the items of the Board's regimen are shown as six-sevenths of the corresponding items in the dietary scale shown in Table XII; the food available for consumption is derived from the figures given in Table XIV by taking the Board's standard family as equivalent to 3.1 men according to Lusk's coefficients, no deduction being made for loss in distribution.

TABLE XIX.

The Board's Regimen compared with the Average Usage of the Community.

Description of Food.	Average Weekly Consumption of Board's Standard Family (3·1 man-units) during the years—		Description of Food.	Board's Regimen for Standard Family (3.1 man-units) for One Week.
	1911.	1916-18.		
	lb.	lb.		lb.
Beef	11·00	6·78	Meat	13·71
Mutton	6·95	4·98	Suet	·86
Pork	·41	·23		
Bacon and Ham	·74	·68		
Fish, fresh, &c.	·45	·78		
,, Preserved	·30	·35		
Total, Meat and Fish..	19·85	13·80	Total, Meat and Suet...	14·57
Potatoes	12·94	9·94	Potatoes	12·00
Flour	2·97	3·04	Flour	3·43
Bread	14·87	13·96	Bread	17·14
Rice	·59	·56	Rice	1·71
Sago and Tapioca	·15	·15		
Oatmeal	·52	·45	Oatmeal	2·57
			Peas	1·71
			Fruit and Vegetables	7·71
			Raisins	·86
Sugar	4·46	4·55	Sugar	3·43
Jam	1·19	1·09	Jam	·86
			Treacle	1·71
Butter	1·86	2·15	Butter	1·29
Cheese	·22	·23		
Milk (fresh)	12·94	15·04	Milk (fresh)	15·43
Tea	·52	·58	Tea	·43

APPENDIX *.

TABLE OF COMPOSITION and Calorie Value of the more Important Foods adopted by the Inter-allied Scientific Food Commission.

The figures are based for the most part on the analyses of American foods, as given in Bulletin 28 (revised edition) of the United States Department of Agriculture, the averages adopted being on the lines of the report of the Royal Society Food (War) Committee (Cd. 8421). In calculating the calorie value from the composition, the factors used were :—

	Calories.
1 gram protein	4·1
1 ,, fat	9·3
1 ,, carbohydrate	4·1

In estimating the food resources or the different allied countries, the Commission decided to take no account of the calorie value of alcoholic drinks (beer, wine, spirits) whether home produced or imported.

Commodity.	Protein.	Fat.	Energy-value per kilo.
Cereals.	Per cent.	Per cent.	Calories.
Wheat and barley flour	11·5	1·0	3,640
Oatmeal	16·0	8·0	4,000
Barley meal	10·5	2·2	3,600
Tapioca, sago, arrowroot, &c.	8·3	0·6	3,650
Maize meal	7·5	4·2	3,500
Rice	8·0	0·3	3,540
Meat.			
Beef (United Kingdom, pre-war)	14·5	22·5	2,690
Beef (United Kingdom, war time, and other countries)	15·0	18·0	2,290
Veal	16·0	6·3	1,230
Mutton (United Kingdom, pre-war)	13·5	30·0	3,340
Mutton (United Kingdom, war time, and other countries)	13·5	24·0	2,790
Lamb	15·0	18·9	2,370
Bacon	9·5	60·6	6,000
Ham	14·5	34·0	3,750
Other pig meat (fresh pork)	10·0	40·0	4,120
Meat offals	20·0	10·0	1,750
Poultry, Eggs, &c.			
Poultry and game	15·0	9·5	1,500
Eggs at 2 oz.	12·0	9·5	1,400
Rabbits, imported (excluding skins)	21·7	10·8	1,900
Fish.			
Herrings	11·6	4·0	850
Other fish, fresh	10·0	1·0	500
Shell fish (without shell)	5·0	1·5	350
Canned and salted fish	20·6	10·3	1,800

* From "The Feeding of Nations" by Professor Starling, London, 1919.

Commodity.	Protein.	Fat.	Energy-value per kilo.
Dairy Produce.	Per cent.	Per cent.	Calories.
Milk	3·3	3·7	700
Butter	1·0	85·0	7,950
Cheese (United States and United Kingdom)	25·0	30·0	4,000
Cheese (France and Italy)	25 0	29·0	3,700
Condensed milk, unsweetened	9·6	9·3	1,700
Condensed milk, sweetened	8·8	8 3	3,300
Margarine	1·2	83·5	7,800
Lard	2·2	94·0	8,800
Fruit.			
Apples	0 3	0·3	480
Bananas	0·7	0 4	600
Oranges	.....	.....	350
Nuts	6·5	22·8	2,600
Fruits, fresh	0·7	0·4	500
Fruits, preserved (without sugar)	2·0	2·0	2,800
Vegetables.			
Chestnuts	.....	.....	2,000
Potatoes	1·8	0 1	700
Beans, peas, and lentils (dried)	24·3	1·3	3,600
Green peas and broad beans (shelled)	7·0	0·5	1,000
Other vegetables	0·75	0·15	200
Preserved vegetables (bottled and canned)	1·5	0·3	380
Sugar, Cocoa, &c.			
Cocoa (and chocolate)	15·0	34·0	4,800
Sugar (taken as refined)	.....	.....	4,100
Molasses	1 0	.....	2,300
Glucose, solid	.....	.....	3,400
Glucose, liquid	.....	.....	3,200
Olive oil (refined)	.....	100·0	9,300

Sydney: William Applegate Gullick, Government Printer—1920.